REMARKS

Response to rejection of claim 18 under 35 U.S.C. § 103 based on Lai, Matsukata, and JP '326

Claim 18 stands rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Lai et al. (U.S. Patent No. 5,871,650), Matsukata (U.S. Patent Application Publication No. 2001/0012505), and the English machine translation of JP 07-330326 (hereinafter "Lai," "Matsukata," and "JP '326," respectively). Applicants respectfully traverse on the basis that (1) Lai fails to disclose or suggest, and in fact teaches against, the presently recited grain boundary layer; and (2) Matsukata does not inherently possess the presently recited grain boundary layer.

Claim 18 recites a zeolite tubular separation membrane comprising a porous tubular support with both ends open and a zeolite membrane which is formed with a plural number of A-type zeolite single crystals on a surface of the porous tubular support. A-type zeolite single crystals exposed on the surface of the zeolite membrane each have a growth axis almost perpendicular to the surface of the porous tubular support, and the membrane has grain boundary layers of 5-50 nm in thickness in spaces among the A-type zeolite single crystals exposed on the surface of the zeolite membrane.

Applicant first traverses on the basis that Lai does not disclose or suggest the presently recited grain boundary layer. The passage cited by the Examiner as allegedly disclosing the recited grain boundary layer among the A-type zeolite single crystals instead relates to the growth enhancing layer, which is the substrate for the zeolite layer. The Office Action cited column 4, line 55 as allegedly teaching the presently recited grain boundary layer. However, this passage does not relate to the presently recited boundary between zeolite crystals. Lai discloses the presence of two layers - a layer (B) of a "growth enhancing layer," and a layer (C) of a

"zeolite layer." See column 2, lines 34-35 of Lai. It is the growth enhancing (GEL) layer described in column 4, line 55 as having the interstitial space of 4-20 nm. Lai does not disclose or suggest that this interstitial space is present in the zeolite layer.

In particular, Lai describes Fig. 6, cited by the Examiner for relating to the zeolite membranes, in part as exhibiting "(B) the growth enhancing layer," and a "(D) a grain boundary." See column 2, lines 34-35 of Lai. Lai also describes that "the columnar zeolite layer is grown on top of a mesoporous growth enhancing layer (GEL)" See column 4, lines 36-37 of Lai. According to Lai, "the GEL layer contains identifiable particles with interstices between said particles of zeolite" and "[s]aid interstices are mesoporous and have size of about 20 to about 2000 Å, preferably from about 40 to about 200 Å." See column 4, lines 53-55 of Lai. Thus, it is clear from Lai that the "20-2000 Å" (i.e., 2-200 nm) and "40-200 Å" (i.e., 4-20 nm) describe the thickness of the mesoporous GEL layer (expressed as "interstices"), which is the substrate for zeolite layer. These values do not relate to the grain boundary spaces.

Applicant further respectfully submits that Lai's disclosure of a "dense mat" does not anticipate or render obvious the presently recited grain boundary. With respect to the value of "a grain boundary zone" in Lai, Lai merely describes that term as follows:

> Dense mat as used herein means that at least 99%, preferably 99.9% of the columnar zeolite crystals have at least one point between adjacent crystals that is ≦20 Å. In the instant invention, the spacing between adjacent crystals is set by a grain boundary zone and the maximum grain boundary zone spacing, absent voids or defects, will be ≦40 Å….

See column 3, lines 47-53 of Lai. Thus, the zeolite layer disclosed in Lai does not have the presently recited "grain boundary layer of 5-50 nm in thickness in spaces among the zeolite single crystals."

In addition, Applicants respectfully submit that Lai does not provide a reason to a person having ordinary skill in the art to alter its teachings to arrive at the presently claimed invention, and in fact teaches away from the presently claimed invention. Lai's disclosure that "the maximum grain boundary zone spacing, absent voids or defects, will be $\leqq 40$ Å" teaches away from the presently recited grain boundary layer (spaces) of 5-50 nm. Lai teaches that the "grain boundary zone," which corresponds to the grain boundary layer of the presently claimed invention, should not be formed. Lai does not disclose or suggest that the "grain boundary zone" is formed in a particular thickness range. Accordingly, a person having ordinary skill in the art reading the disclosure of Lai would not have a reason to alter the teachings of Lai in a manner which would lead them to the presently claimed invention.

Finally, Applicants note that, as the Examiner has appreciated, the zeolite layer disclosed in Lai is MFI zeolite, and is not the presently recited A-type.

Accordingly, Applicants respectfully submit that Lai fails to disclose or suggest the presently recited grain boundary layer.

With respect to Matsukata, Applicants respectfully traverse on the basis that the position of inherency set forth in the Office Action is incorrect. In particular, the Office Action set forth the position that "Matsukata teaches zeolite membranes….The grain boundary layer thickness in the range 2-50 nm would be an inherent property of the zeolite membrane." See the Office Action at page 3. However, Applicants submit herewith a description of a reproduction of Example 1 in Matsukata, in which it is demonstrated that the thickness of the portion corresponding to the grain boundary layer of the presently claimed invention in the MOR type zeolite of Matsukata is outside of the presently recited range of 5-50 nm.

According to the description of Example 1 in Matsukata, a MOR zeolite membrane was formed on the outer peripheral surface of a porous alumina supporting tube. The zeolite membrane thus formed was observed by TEM using a field emission type transmission electron microscope (HF-2000, manufactured by HITACHI) under an operation condition of 200kV. The result is shown in the following Fig. 1. Fig. 1 may be compared with Fig. 2, which is the A-type zeolite disclosed in Example 1 of the present specification.

As shown in Fig. 1, it is clear that in the MOR zeolite membrane disclosed in Matsukata, the grain boundary layer of 5-50 nm in thickness does not exist at the space between single crystals.

FIG. 1

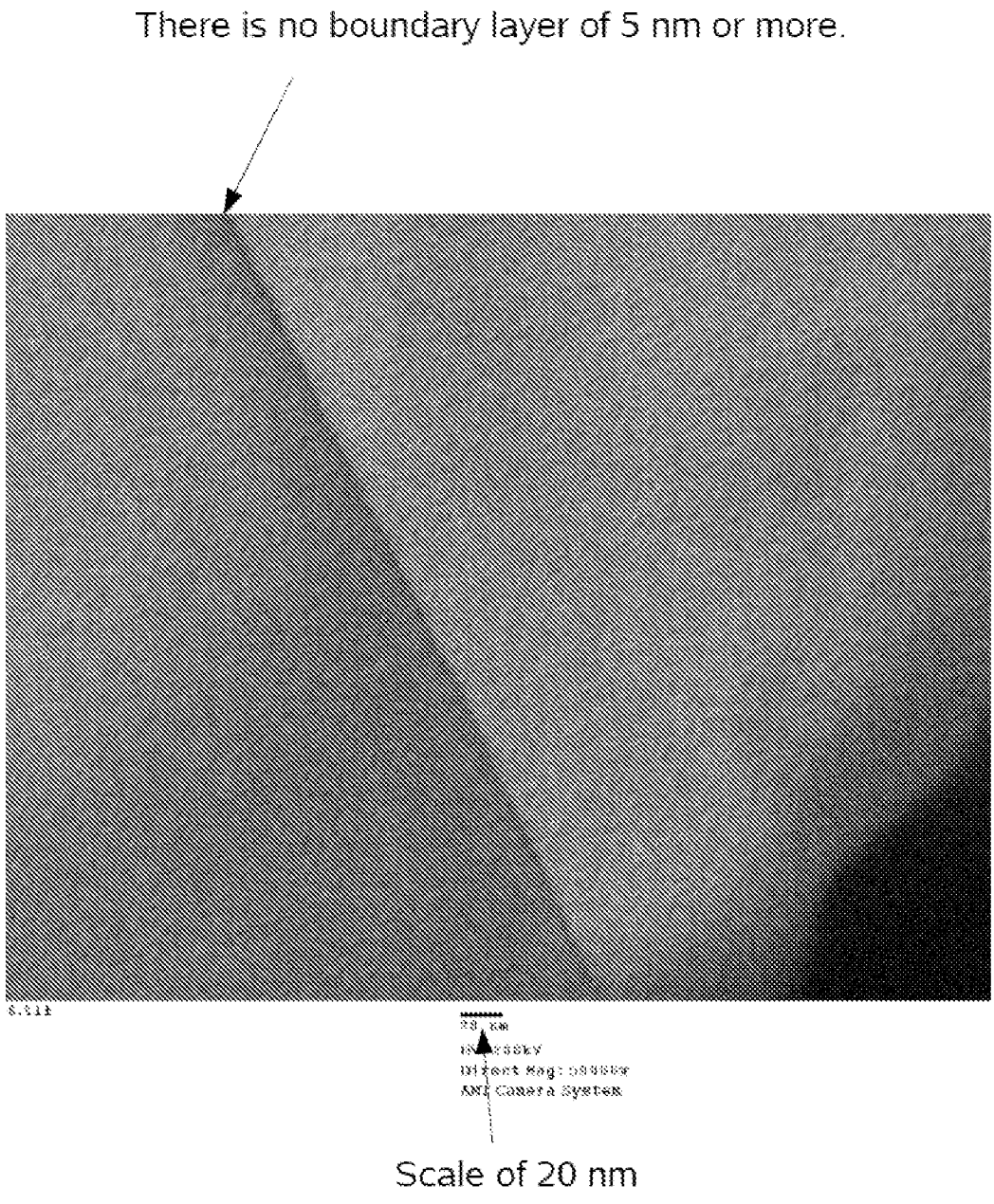
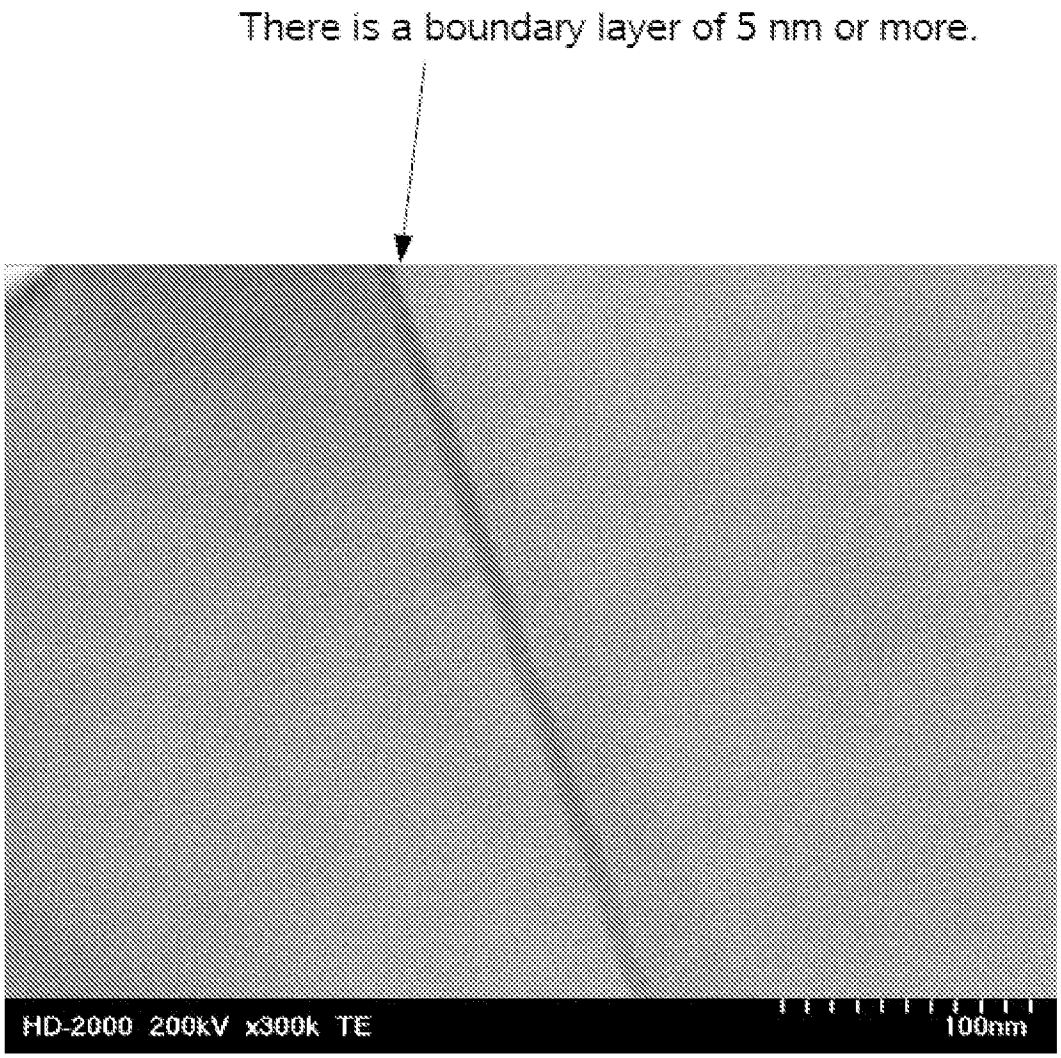


FIG. 2


There is a boundary layer of 5 nm or more.
HD-2000 200kV x300k TE
100nm

Accordingly, the presently recited grain boundary layer is not an inherent property of Matsukata.

With further respect to the inherency of the grain boundary thickness, Applicants further note that Lai's disclosure that grain boundary spaces may be variably set to be 40 Å or less shows that the grain boundary thickness is not necessarily an inherent property.

JP '326 does not remedy the deficiencies noted above, as it merely discloses an A-type zeolite membrane is formed on a substrate. JP '326 does not disclose or suggest that the A-type zeolite membrane has a grain boundary layer of 5-50 nm in thickness at the space between single crystals.

Accordingly, Applicants respectfully submit that the presently claimed invention is not rendered obvious by the cited references. Applicants thus respectfully request the reconsideration and withdrawal of this rejection.

Conclusion

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,

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